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Process simulation-based optimization of a commercial amine gas sweetening unit

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Amine sweetening units are integral parts of any natural gas plant with the objective of recovering mainly H_2S and CO_2 from gas streams before the latter are transported or used to produce LNG. Safety, environmental, operational and economic considerations govern the essence of removing these acid gases: H_2S is toxic and corrosive while CO_2 reduces the heating value besides being corrosive. In most cases, sales gas revenues far outweigh the capital and operating costs of these gas plants. Nevertheless, Emphasis in recent years has been on increasing gas plants efficiency due to exploration of sour gas fields with high H_2S and CO_2 concentrations which pose challenge to their profitability. Indeed, Abu Dhabi has significant developed and undeveloped sour gas reserves with high H_2S and CO_2 content (5% to 30%). This indicates the necessity of investigating several optimization schemes in order to maintain the economics of Abu Dhabi different gas plants.

This paper discusses the prominence of optimum operating conditions in amine gas units to best improve Abu Dhabigas plants' efficiency without additional capital expenditure. Effect of lean amine temperature and amine strength on plant performance in several aspects is explained through sensitivity analysis. To this end, a kinetics based process simulation model has been developed for a commercial gas sweetening unit of a gas plant located in Abu Dhabi. Trends of various process variables such as sweet gas H_2S, CO_2& H_2O, steam consumption rate and solvent circulation rate as function of the two abovementioned parameters are explained in detail. It is demonstrated through this study that lower amine temperature ($47^{O}C$) provides significant reduction in solvent circulation rate, steam consumption rate, pumping duty, dehydration unit load while posing no risk of hydrocarbon condensation and hydrate formation. Also, it is found that amine strength of 50% is best suited for amine-sweetening unit's operating conditions as it resulted in potential savings in operating costs without increasing the risk of corrosion and fouling. To provide guidelines for optimum plant operations, DCS (Distributed Control System) lookup tables for the commercial amine-sweetening unit have also been generated and successfully tested.

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